ICE COLUMNS IN GRAVELLY SOIL.

By E. D. BOURNE. Dated Taylorsville, Ky., February 22, 1908.

In the MONTHLY WEATHER REVIEW for October, 1907, is a notice of an article on the formation of ice columns in gravelly soil, by Professor Goto, and the statement that an endeavor would be made to get a translation, or abstract of the same.

I have been interested, in an unscientific way, in this subject for years. About thirty years ago I noticed that occasionally a tiny column would shoot up above the general level of the group. Upon investigation I found that every one of these taller columns formed on a seed of horseweed (tall ragweed), and always on the end opposite to the germ end.

I have at various times made similar examinations and always found the same result.

POPOF AND ERMAN ON THE USE OF KITES IN METEOROLOGY.

In 1893 Professor Harrington took up the development of kite work in the Weather Bureau and during the years 1895, 1896, 1897 in successive numbers of the MONTHLY WEATHER REVIEW we publisht various historical references to those who advocated or used the kite as a means of sending aloft our meteorological apparatus. We now take pleasure in referring to still another instance that has lately come to our knowledge and that is eminently worthy of being added to the record. We allude to a memoir by Prof. A. Popof, of Moscow and Kazan, published in Russian in the Journal of the Minister of Public Education for September, 1846, but known to us only thru an abstract publisht in 1849 by Prof. A. Erman at p. 374–385 Vol. VII of his Archives of Science in Russia. Altho Professor Erman is most widely known by his important works in terrestrial magnetism yet his interest in climatology is shown by many articles in his archives and on every page of his Journey Around the Globe. His profound knowledge of dynamic meteorology is illustrated by his memoir of February, 1868, on the general circulation of the atmosphere publisht in Vol. LXX of the Astronomische Nachrichten.

In the present case Erman, writing in 1849, prefaces his abstract of Popof's memoir of 1846, by the remark:

> It is to be regretted that the paper kite which in Franklin's hands brought us such important conclusions as to the electricity of the atmosphere is now scracely noticed by physicists. By giving it a proper size this apparatus can, however, be applied with great advantage to the determination of the temperature, the wind direction, and the quantity of aqueous vapor in the upper strata of the atmosphere. Indeed for small altitudes it has some advantage over balloons, since kites stand for a long time almost immovable so that one can determine the altitude by other means than by angular measurements which take up much time and demand special apparatus. For such altitude determinations the equation of the curved line formed by the kite-string seems appropriate and therefore the mathematical expressions leading to this end will here be given, and the meteorologists will have to use these in order to determine the altitude of the kite itself or the altitude of any point on its string.

Erman adds that if elastic springs be inserted in the kite line at the reel and again higher up say at the kite and records be made of the tensions at any moment then a simple formula will give the altitude of the upper spring.

We need hardly repeat the mathematical formulas of Popof, or Erman's improvements thereon; they may well be useful when the kites are not too high and the wind fairly uniform, but are not adapted to the irregularities of atmospheric currents and will not give the accuracy demanded in the modern practise of flying many kites tandem in order to attain the great altitudes that the Hargrave kite has now brought within our reach. It is interesting to reflect that if Professor Popof could have put his ideas into practical execution in Russia in 1846 meteorology might have gained fifty years over its present condition. As a rule, however, knowledge progresses by a system of irregular steps, first an idea, then an experiment; first the failure of an old theory then the starting of a new theory. Observation, experiment, hypothesis, philosophy, and theory follow each other in rapid succession. Mathematical seminaries, experimental laboratories, and observations under natural conditions must all be maintained. The progress of every branch of science as recorded in the literature of the last three hundred years shows an instructive series of failures and successes. The experiments of Alexander Wilson in 1749 were not repeated until the importance of upper air exploration was realized and until the students of the modern weather map perceived that long-range forecasts and even daily forecasts will never become satisfactory until we fully understand the upper currents and the general circulation of the atmosphere. It is to the study of this latter subject that kites and balloons, mountain stations and cloud observations are now essential, while the interpretation of the results needs the help of the best mathematical physicists.

It is often stated as a reproof to eminent philosophers that they are not "practical" that they "know" but can not "do." However, in the case of Popof, as of very many meteorologists, the money needed for practical work was not available and he could only mark out the methods and the paths for others to pursue. Fortunate is the "practical man" who has reliable theoretical men to guide him in the exploration of nature. The captain of a vessel would be hopelessly lost at sea if there was no navigating officer to show the course.—*C. A.*

FORECASTING ON THE PACIFIC COAST.

By Prof. ALEXANDER G. MCADIE. Dated San Francisco, Cal., February 4, 1908.

In an address delivered before the British Association in 1902, Prof. Arthur Schuster exprest the opinion that "meteorology might be advanced more rapidly if all routine observations were stopped for a period of five years, the energy of observers being concentrated on the discussion of the results already obtained." The accompanying article describes an attempt to partially meet the criticism by utilizing, for forecasting work on the Pacific coast, the charts published each month in the MONTHLY WEATHER REVIEW. No working meteorologist will fully agree with Doctor Schuster's opinion exprest above; yet the need of further study of the data now accumulated is evident and the limitations of our present methods manifest. And yet, has not too much been expected in the matter of forecasts. If not at the present time, certainly in the past, results have been expected entirely incommensurate with the facts and data furnished. Nor is there any present method of verification which does or can do full justice to the forecaster.

In recent years the recognition of the part played by the larger pressure areas, the so-called permanent and subpermanent continental and oceanic areas, has given the forecaster a possible means for undertaking seasonal forecasts with some prospect of success. The importance of extending the area of reports is now more than ever recognized. With the exception of the exploration of the upper air, the study of seasonal displacements of the areas of sea-level pressure offers the most promising field for helpful work in forecasting.

Over the Pacific Ocean, plainly, not less but more observations are needed. Absence of reports now handicaps the forecasters on the Asiatic as well as on the American side of the Pacific. It is conceivable that with a close working cooperation between the Japanese, Indian, Chinese, and Philippine weather services and those of Mexico and the United States, including Alaska and British Columbia, aided by the receipt of wireless weather messages from vessels at sea, the forecasting officials of these services would be in a position to undertake general forecasts for a period of a week or longer, eventually determining seasonal forecasts. And it may not be amiss to call attention to the excellent work done in forecasting on the Pacific coast, and to say that, valuable as the daily forecasts have been, the same degree of efficiency for longer period forecasts would be of much greater value. The importance of seasonal forecasts for the Asiatic districts is widely recognized. It is not so generally known that there are well marked dry and wet periods in southern California and Arizona; and that some knowledge of the likelihood of abnormal conditions, especially dry winters, could be directly utilized by farmers and stockmen.

In this paper a description is given of a device, a glass map tray, which meets to some degree the requirements alluded to above: 1. Extending the area of reports. 2. Permitting comparison with typical conditions. 3. Permitting the study of of seasonal displacements of sea-level pressures. While the immediate problem was to bridge the Pacific Ocean, it appears that the method can be used advantageously in bridging the Atlantic. In the illustration (fig. 1, not reproduced) there is shown a series of glass maps for the month of January, 1908, covering the United States and extending eastward over the Atlantic and over Europe. In all an area of many million square miles is thus spread before the eye of the forecaster. A basic fact in meteorology, namely the general drift of the lower air from west to east is utilized in this device, by either moving each map a proper distance eastward every twenty-four hours or by moving a skeleton map of the United States an equivalent distance westward. The positions of high and low areas during and subsequent to their passage across the continent are thus shown. Forecasters on the Atlantic coast are enabled to follow the pressure areas long after these have past beyond the limits of land reports. Under the second requirement, comparison with typical conditions, fig. 1, shows a typical wet month, January, 1896. The sea-level isobars, isotherms, and resultant winds for any month, as charted in the MONTHLY WEATHER REVIEW, are thus instantly available for study. The normal pressure on the sea-level plane taken from the Report on Barometry can serve as a base for pressure departures; altho in the work at San Francisco where morning and evening forecasts are issued, it is necessary to use corrected normals. An enlarged portion of the frame is shown on fig. 2 (not reproduced).

TABLE 1—*San Francisco rainfall, monthly, seasonal, and annual, 1849–1907.*

Season.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.	Seasonal.	Year.	Annual.
1849–'50	0.00	0.00	0.00	3.14	8.66	6.20	8.34	1.77	4.53	0.46	0.00	0.00	33.10	1850	17.40
1850–'51	0.00	0.00	0.33	0.00	0.92	1.05	0.72	0.54	1.94	1.23	0.67	0.02	7.42	1851	15.60
1851–'52	0.00	0.02	1.03	0.21	2.12	7.10	0.58	0.14	6.68	0.26	0.32	0.00	18.46	1852	27.29
1852–'53	0.00	0.00	0.00	0.80	5.31	13.20	3.92	1.42	4.86	5.37	0.38	0.00	35.26	1853	21.17
1853–'54	0.00	0.04	0.46	0.12	2.28	2.32	3.88	8.04	3.51	3.12	0.02	0.08	23.87	1854	22.45
1854–'55	0.00	0.01	0.15	2.43	0.34	0.87	3.67	4.77	4.64	5.00	1.88	0.00	23.76	1855	26.39
1855–'56	0.00	0.00	0.00	0.00	0.67	5.76	9.40	0.50	1.60	2.94	0.76	0.03	21.66	1856	22.31
1856–'57	0.02	0.00	0.07	0.45	2.79	3.75	2.45	8.59	1.62	0.00	0.05	0.12	19.91	1857	20.96
1857–'58	0.00	0.05	0.00	0.93	3.01	4.14	4.36	1.83	5.55	1.55	0.34	0.05	21.81	1858	23.46
1858–'59	0.05	0.16	0.00	2.74	0.69	6.14	1.28	6.32	3.02	0.27	1.55	0.00	22.22	1859	21.39
1859–'60	0.00	0.02	0.03	0.05	7.28	1.57	1.64	1.60	3.99	3.14	2.86	0.09	22.27	1860	21.18
1860–'61	0.21	0.00	0.00	0.91	0.58	6.16	2.47	3.72	4.08	0.51	1.00	0.08	19.72	1861	25.52
1861–'62	0.00	0.00	0.02	0.00	4.10	9.54	24.36	7.53	2.20	0.73	0.74	0.05	49.27	1862	38.63
1862–'63	0.00	0.00	0.00	0.52	0.15	2.35	3.63	3.19	2.06	1.61	0.23	0.00	13.74	1863	15.10
1863–'64	0.00	0.00	0.03	0.00	2.55	1.80	1.83	0.00	1.52	1.57	0.78	0.00	10.08	1864	21.64
1864–'65	0.00	0.21	0.01	0.13	6.68	8.91	5.14	1.34	0.74	0.94	0.63	0.00	24.73	1865	14.06
1865–'66	0.00	0.00	0.24	0.26	4.19	0.58	10.88	2.12	3.04	0.12	1.46	0.04	22.93	1866	36.28
1866–'67	0.00	0.00	0.11	0.00	3.35	15.16	5.16	7.20	1.58	2.36	0.00	0.00	34.92	1867	30.64
1867–'68	0.00	0.00	0.04	0.20	3.41	10.69	9.50	6.13	6.30	2.31	0.03	0.23	38.84	1868	30.17
1868–'69	0.00	0.00	0.00	0.15	1.18	4.34	6.35	3.90	3.14	2.19	0.08	0.02	21.35	1869	22.59
1869–'70	0.00	0.00	0.12	1.29	1.19	4.31	3.89	4.78	2.00	1.53	0.20	0.00	19.31	1870	16.24
1870–'71	0.00	0.00	0.03	0.00	0.43	3.38	3.07	3.76	1.31	1.89	0.23	0.01	14.11	1871	27.53
1871–'72	0.00	0.02	0.00	0.07	2.81	14.36	4.00	6.90	1.59	0.81	0.18	0.04	30.78	1872	22.42
1872–'73	0.01	0.00	0.04	0.11	2.79	5.95	1.58	8.94	0.79	0.43	0.00	0.02	15.66	1873	18.56
1873–'74	0.01	0.08	0.00	0.83	1.16	9.72	5.66	2.21	3.36	0.90	0.66	0.14	24.73	1874	22.52
1874–'75	0.00	0.00	0.02	2.69	6.55	0.33	8.01	0.32	1.30	0.10	0.22	1.02	20.56	1875	22.63
1875–'76	0.00	0.00	0.00	0.24	7.27	4.15	7.55	4.92	5.49	1.29	0.24	0.04	31.19	1876	23.54
1876–'77	0.01	0.01	0.38	3.36	0.25	0.00	4.32	1.18	1.08	0.26	0.18	0.01	11.04	1877	11.93
1877–'78	0.02	0.00	0.00	0.65	1.57	2.66	11.97	12.52	4.56	1.06	0.16	0.01	35.18	1878	33.26
1878–'79	0.01	T.	0.55	1.27	0.57	0.58	3.52	4.90	8.75	1.89	2.35	0.05	24.44	1879	30.76
1879–'80	0.01	0.02	T.	0.78	4.03	4.46	2.23	1.87	2.08	10.06	1.12	0.00	26.66	1880	30.07
1880–'81	0.00	0.00	0.00	0.05	0.33	12.33	8.69	4.65	0.90	2.00	0.22	0.69	29.86	1881	23.73
1881–'82	0.00	0.00	0.25	0.54	1.94	3.85	1.68	2.96	3.45	1.22	0.21	0.04	16.14	1882	18.67
1882–'83	0.00	0.00	0.26	2.66	4.18	2.01	1.92	1.04	3.01	1.51	5.52	0.01	20.12	1883	15.43
1883–'84	0.00	0.00	0.42	1.48	1.60	0.92	3.94	6.65	8.24	6.33	0.23	2.57	32.38	1884	38.82
1884–'85	T.	0.04	0.33	2.55	0.26	7.68	2.53	0.30	1.01	3.17	0.04	0.19	18.10	1885	23.18
1885–'86	0.06	T.	0.11	0.72	10.06	4.99	7.42	0.24	2.07	5.28	0.37	0.01	31.33	1886	20.02
1886–'87	0.23	T.	0.01	1.48	0.84	2.07	1.90	9.24	0.84	2.30	0.06	0.07	19.04	1887	19.04
1887–'88	T.	0.01	0.29	T.	0.99	3.34	6.81	0.94	3.60	0.11	0.38	0.27	16.74	1888	23.03
1888–'89	0.01	0.01	0.98	0.13	3.99	5.80	1.28	0.72	7.78	0.96	2.17	0.03	23.86	1889	36.94
1889–'90	0.01	T.	T.	7.28	2.90	13.81	9.61	5.16	4.73	1.18	1.07	0.10	45.85	1890	25.43
1890–'91	0.02	0.00	0.31	0.00	0.00	3.25	0.98	7.26	1.96	2.44	1.25	0.11	17.58	1891	21.11
1891–'92	0.10	0.02	0.77	0.04	0.56	5.62	2.42	2.90	2.85	1.39	1.86	T.	18.53	1892	22.08
1892–'93	0.00	0.00	0.02	1.65	3.91	5.08	3.05	2.75	4.08	1.03	0.15	0.03	21.75	1893	17.91
1893–'94	0.02	0.00	0.21	0.16	4.18	2.25	5.99	2.69	0.60	0.50	1.31	0.56	18.47	1894	24.32
1894–'95	T.	0.00	1.05	1.73	0.88	9.01	6.99	2.31	1.89	1.24	0.60	0.00	25.70	1895	17.18
1895–'96	0.01	0.00	0.77	0.11	1.78	1.43	8.14	0.28	2.85	5.16	0.72	0.00	21.25	1896	28.25
1896–'97	0.04	0.09	0.52	1.55	4.56	4.34	2.26	4.41	4.56	0.27	0.61	0.22	23.43	1897	16.40
1897–'98	T.	T.	0.10	1.70	1.05	1.22	1.12	2.13	0.24	0.19	1.44	0.19	9.38	1898	9.31
1898–'99	0.00	T.	1.06	0.86	0.46	1.62	3.67	0.10	7.61	0.62	0.86	0.01	16.87	1899	23.23
1899–'1900	0.00	T.	0.00	3.92	3.79	2.65	4.11	0.64	1.91	1.08	0.32	0.05	18.47	1900	15.33
1900–'01	T.	T.	0.46	1.48	3.91	1.37	5.79	5.03	0.80	1.64	0.69	T.	21.17	1901	19.75
1901–'02	T.	T.	0.78	0.64	3.48	0.90	1.23	7.27	2.65	0.98	1.05	T.	18.98	1902	19.18
1902–'03	T.	T.	T.	1.70	1.98	2.82	3.73	1.76	6.23	0.56	T.	T.	18.28	1903	18.33
1903–'04	0.00	T.	T.	0.17	4.25	1.68	1.05	5.89	6.01	1.29	0.30	T.	20.59	1904	24.72
1904–'05	0.02	0.06	5.07	2.37	1.07	1.59	4.04	2.70	3.15	1.33	2.05	0.00	23.45	1905	16.24
1905–'06	0.00	T.	T.	T.	0.92	2.05	3.90	4.30	5.02	0.92	2.75	0.56	20.42	1906	26.34
1906–'07	0.08	0.11	0.18	0.03	1.59	6.90	4.41	3.02	8.42	0.11	0.04	1.28	26.17	1907	....
Average (58 years)	0.02	0.02	0.30	1.02	2.66	4.68	4.72	3.54	3.37	1.74	0.75	0.16	22.98	....	22.77

The third requirement, that of quick recognition of seasonal pressure displacement, is met in the following manner: Records of many years are assembled. Rainfall tables embracing a period of nearly sixty years are prepared for at least three stations in California (e. g., Table 1, San Francisco rainfall, 1849–1907). While these printed tables give only the intensity or amount of precipitation, auxiliary tables give the frequency, or number of rainy days. Thus the forecaster has a ready reference table of wet and dry months. He has also that which is of more value, viz, abnormal periods, or months when there was little rain and months of excessive rain during winter. He can also refer quickly to months of excessive rain during the normally dry period. Confining the discussion for the present to a single month (e. g., January) it is seen that for the central portion of California there have been seven abnormally dry periods in the heart of the wet season; namely, in 1851, 1852, 1889, 1891, 1898, 1902, and 1904. For some of these we have the monthly charts of isobars available, and by making a composite we can formulate the following general laws for forecasting:

A. When the continental high overlies Oregon, Idaho, Utah and Nevada, the general drift of the surface air is from the north or northeast; and such a circulation favors fair weather, with little precipitation. Individual highs are likely to move slowly eastward. Individual lows are restricted to northern counties, and pass as a rule eastward without extending southward.

From the nine abnormally wet seasons, viz., 1850, 1856, 1862, 1866, 1875, 1877, 1881, 1890, and 1896, we learn, using such charts of the Monthly Weather Review as are available, that—

B. When the north Pacific low area extends well southward along the Oregon coast and the continental high overlies Assiniboia and Montana, the general drift of the surface air in California is from the south or southeast. Conditions favor unsettled weather, with frequent and heavy rains west of the Sierra and heavy snowfall in the Sierra. Individual highs appear with little warning north and east of the Kootenai, and move as a rule slowly south. Individual lows appearing over Vancouver Island and the north coast of Washington, deepen and also extend southward, the rain area reaching northern California in twelve hours, the central coast in twenty-four hours, and the coast south of Point Conception in thirty-six hours.

Combining A and B we can estimate the relative change in pressure and air movement for a given increase of precipitation. If records of duration of cloudiness and rain were available, some relation might be found between the direction and strength of surface winds, and duration of rain.

Taking up the abnormal periods for February, we find some notably dry months, e. g., 1864, when the entire month was without rain; 1850, 1852, 1856, 1886, each with four rainy days; 1875 and 1883, with three rainy days, and 1889, with but two rainy days. Other dry Februaries were 1885, 1896, and 1900. We have no records for 1864; but we feel able because of these studies to chart the probable pressure distribution for that month; namely, unusually high pressure over Idaho, Oregon, and Washington, with surface winds from the north and east.

With regard to wet periods, we find that the following Februaries were abnormally wet, 1854, 1857, 1859, 1862, 1867, 1878, 1887, 1891, 1902.

If we consider the number of rainy days, rather than the amount of rain, we have the following as abnormally wet Februaries: 1854 (16 days), 1857 (15 days), 1859 (18 days), 1872 (17 days), 1873 (17 days), 1878 (19 days), 1887 (16 days), 1891 (19 days), 1897 (17 days), 1902 (19 days), 1904 (16 days).

Composites of these confirm the law given above under B.

As illustrative of the difference in the amount of rain falling in a dry and a wet month, we give the isohyets for California for January, 1902—a dry winter month; and for February, 1902—a wet winter month (see Charts IX and X).

For the dry month there was an estimated deficiency, determined from normals for 194 stations, of 81 millimeters (3.17 inches) or approximately 35,755 million tons of water.

For the wet month, the excess of precipitation was 131 millimeters (5.17 inches) or 58,320 million tons of water.

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California offers exceptionally good opportunities for studying seasonal variations and climatic abnormalities. Supplementing the comparatively brief record of nearly sixty years, we have meager records of extremely dry periods noted by the failure of crops during the time when the Mission Fathers controlled agricultural and stock interests. There was, for example, a failure of the crops at all of the missions in 1829, and we naturally infer that there was a period of drought in the winter months. It is an interesting fact, but whether a coincident or not we do not say, that a drought period occurred in 1863–64, or at a time corresponding to the Brückner 35-year period. Again, after nearly the same interval we have another drought period 1897–98. Crop yields, however, are influenced by many other factors than that of rainfall.

In California there is a growth of Sequoia, both *sempervirens* and *gigantea*, where rings of annual growth may be traced for periods extending in some cases to nearly three thousand years. In these rings we have to some degree an integrated history of the seasons and possibly the periods of extreme drought and excessive rainfall could be determined. The tree, however, is not a ready witness and the study, when made, must be entrusted to careful and competent hands.

In communicating the preceding paper, which is printed by special order of the Chief of Bureau, Prof. Alexander G. McAdie, says:

"As the paper touches upon the possibility of seasonal forecasts on the Pacific coast, or rather upon forecasts for periods of ten days or longer, I would appreciate a personal reading by the Chief of the Weather Bureau and an expression of opinion from him, as well as any comment or criticism which my colleagues in the Forecast Division may care to make."

Accordingly the following remarks are appended:

While it is far from true that conditions of pressure and temperature presented by a map of one day will represent conditions that will exist 15°, more or less, to the eastward on the following day, yet the tracings on glass are, in a measure, useful. The paper, as a whole is interesting, and its publication is recommended.—*E. B. G.*

As yet I am very skeptical as to the possibility of extending our period of forecasting effectively, chiefly, as stated by Professor Henry, because of the want of persistence of any well-defined type of pressure distribution, and because of the comparative uncertainty as to the direction of movement of areas of high and low pressure, even for twenty-four hours in advance. However, I think Professor McAdie's paper a very interesting one, and of value that will fully justify its publication.—*H. C. F.*

The relation of the pressure distribution for several months to the weather for the corresponding period has been a fruitfull subject of discussion for some years. The work by Hildebrandsson, de Bort, and Hann, in Europe, is well known. These scientists have shown that the weather of northwestern Europe is related in a general way to the pressure distribution over the Azores and in the vicinity of Iceland, respectively.

The author of the paper now under consideration calls attention to the apparent connection between the monthly pressure distribution on the Pacific coast and the rainfall; also to a device for projecting the current distribution of pressure forward over 15° of longitude, and discusses the utility of this device in forecasting.

That the weather experienced from day to day depends almost wholly upon the pressure distribution goes without saying, but when an attempt is made to apply the knowledge thus far gained as to the influence of the so-called permanent and subpermanent continental and oceanic areas on the weather of both adjacent and somewhat remote regions, the same difficulties are met that are encountered in the twenty-four hour forecasts, viz, the inability of the forecaster to fix, with any degree of certainty, the time that a condition once establisht will persist. I speak now more especially of the so-called continental areas of high pressure and forecasting in the United States. The movement of highs and lows in this country, especially in the cold season, is far too rapid to permit of the formation of areas of either high pressure or low pressure that can properly be called even subpermanent.

Even the so-called "Plateau high," an area of high pressure that occasionally lodges over the Great Basin in winter, does not persist on the average over two or three days. There are times, of course, when it persists for a longer period, but on these occasions it is believed that the endurance beyond the average period is due to the inflow of cold air from the northwest. In other words, the Great Basin, owing to the topographic surroundings, actually serves as a basin or reservoir in which part of the cold air which has a slow eastward or southward motion is entrapped.

One of the reasons for entertaining this view is the fact that offshoots from the "Plateau high" are frequently discharged to the eastward or southeastward. After the discharge of an offshoot the parent high soon disintegrates. It is also believed that owing to local radiation, and the drainage of cold air into the valleys occupied by Weather Bureau stations, the sea-level pressures for the Plateau region, are at times greatly affected by these local surface temperature falls.

An area of high pressure *firmly lodged* over the Great Basin is a most important asset to the forecaster, not only on the Pacific slope, but eastward from the Rocky Mountains including the Northern and Central States.

As I said before, according to my experience, there is no distinct pressure formation in this country that approaches a condition of subpermanency. There are times when the highs and lows follow each other in nearly the same path. When this condition prevails it is customary to say that a certain type prevails. The same phenomenon has been observed in Europe: See Nils Ekholm in the January, 1907, Meteorologische Zeitschrift, "Über die Unperiodische Luftdruckschwankungen und einige damit zusammenhängende Erscheinungen." (On the nonperiodic pressure variations and some phenomena in connection therewith.)

It seems to me that it would be profitable to study the daily weather maps in periods of less than a month since the latter period is too apt to include the records of more than one type. It might be possible to do this for the Pacific coast where the atmospheric movements are less complicated than in eastern districts.

As an illustration of what one would meet in attempting to correlate monthly mean pressures and weather conditions, I submit, herewith, copies of the monthly mean pressures for March, for the years 1902 to 1906, together with the paths of highs and lows on the Pacific coast and over the Plateau region. But one of these months (March, 1904) shows a steadiness in the movement of lows that would be useful to the forecaster. (Charts XI to XV.)

Aside from the forecasting point of view considerable interest attaches to this subject on account of its bearing upon a rational explanation of climate. In this connection see Bulletin Q, under "Seasonal variations of the weather."

In regard to Professor McAdie's second proposition, I would say that we are never certain that the pressure distribution and the weather conditions existing at any moment of time will match the actual conditions to the eastward in the next twenty-four hours.—*A. J. H.*

CAN WE PROTECT AGAINST TORNADOES?

A well-constructed conductor is a fairly reliable protection against destruction by lightning, but one must be inside the protected building, as there is no assurance of safety on the outside. A dwelling *may* be so constructed as to pass uninjured thru a hurricane, tornado, earthquake, flood, or fire, tho it is rare that such are built, and that which is safe against one kind of visitation may not be so for another.

The following correspondence shows one phase of the question of protection. We should like to have some one compile enough data to give us a fairly correct idea as to whether it is best to be frightened at every storm cloud and run to the shelter of the "tornado cave," or whether we may not as well be brave and calmly await the dread visitation, since it is most likely to pass us by. As the result of his extensive studies Lieut. John P. Finley maintained that the best we can do is to watch the distant tornado, and if it seems to approach us then move away toward the left; so far as we have learned, this still continues to be the best rule.

(1) LETTER FROM A CORRESPONDENT TO THE CHIEF OF BUREAU.

I am going to establish in this city a system which will give us warning of the approach of tornadoes, which is as follows:

We will run a pole line around our city at a distance of four miles, which is connected to an alarm in the city by wires, using the very best of wire and putting up the line in the most substantial manner. There will be two wires on this circuit around the town. We will place instruments a quarter of a mile apart on this line, to be adjusted to short-circuit the wires by making an electric contact, should a change in the atmosphere pressure (of as much as three-tenths of an inch) take place within five minutes.

The magnetic apparatus for giving an alarm in the city is arranged so that if one or both the wires are broken it will cause an alarm to be given, or should the wires touch one another by being twisted together it would give an alarm; also should the instrument short-circuit the wires by the sudden change in the air pressure, we would receive an alarm. We will have notice in advance of the tornado by the time it would take it to travel from the instrument or pole line to the city, and as the line is all around the city, at a distance of four miles, it would be unable to reach the city from any direction without giving us an alarm.

I have kept in touch with the great work that your Bureau is doing under your able management, and I earnestly hope that you and your good workers may live to quite an old age, as you have done much to overcome ignorance and superstition in regard to the many fake ideas of the people in regard to forecasting the weather.

REPLY TO THE ABOVE LETTER BY THE EDITOR.

You propose to surround your city by a double line of telegraph wire inclosing an area about 8 miles in diameter or 25 miles in circumference. At every quarter mile of this circumference (100 stations in all) you will place an apparatus that will automatically short-circuit the line whenever the atmospheric pressure rises or falls at the rate of three-tenths of an inch in five minutes, or faster. The wires will also be short-circuited, or an alarm given, if either wire is broken or if the wires touch each other. You think that this system of alarms will protect the city from the unexpected arrival of a tornado.

The statistics of tornado frequency show that a region of 1 square mile any where in Missouri is not very apt to experience a tornado, the probability being one-sixteenth of one per cent per century, so that a region 4 miles square would have a probability of 1 per cent per century; that is to say, it will presumably have a tornado once in ten thousand years. It is therefore probable that your system of wires and apparatus would have to be kept in working order many years before it could be of use; and unless it be kept in perfect repair, at great expense, it will be out of order and useless when the tornado comes. For these reasons many schemes analogous to yours which have been proposed in the last forty years have been abandoned as impracticable. If you have any statistics showing that tornadoes are specially frequent in the neighborhood of .... I should be glad to receive them and revise this calculation.

You state that you are going to establish your system around ....; does this mean that you are going to do it at the expense of the city, or as a private enterprise?

(3) SECOND LETTER FROM A CORRESPONDENT.

In reply to your letter, I will say that I am unable to give you any additional information in regard to the frequency of tornadoes in this State, for the following reasons:

1. That most newspapers, as well as the public in general, call tornadoes "cyclones."
2. I have only been able to visit a few of the damaging storms to ascertain what they were.
3. That I believe that only a small per cent of the tornadoes reach the earth's surface, and it seems to me that it would be difficult on this account to ascertain or even attempt to approximate the number of tornadoes in any locality.

I quite agree with you that it is only a small per cent of tornadoes that do damage in this State, but there are so many dark, dangerous, and threatening-looking clouds that we will be uneasy, and this will cause us to always keep our alarm system in the best of condition for fear that they are tornadoes.

I have only this one life to live, and being healthy and enjoying it there is no expense I would not undergo to protect it, as I prefer living to any other state or condition I can imagine. We will not install this